# 5.—THE PERMIAN CORALS OF WESTERN AUSTRALIA.

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## INTRODUCTION.

This paper revises those species of Rugose Corals already described from the "Permo-Carboniferous" strata of Western Australia, and describes three new species and one new genus. It investigates a type of septal structure characteristic of Permian Rugosa. It also re-describes the Tabulate Corals reported from the "Permo-Carboniferous" of Western Australia, includes a new species, and investigates the arrangement of their calcareous fibres. All the localities involved are shown to be Permian.

The table gives the localities and the species in the order of their description:—

| | Fossil Range, North of Lyons River, Gascoyne River. | Fossil Range, near junction of Gascoyne and Lyons Rivers, Lat. 25° S. | Gascoyne River. | Fossil Cliff, Irwin River. | Locality 1, Callytharra Limestone, Wooramel River [Wade.] | Creek half-mile west of Callytharra Spring, Wooramel River. | Callytharra Limestone, Wooramel River. | Two miles south-east of Christmas Creek Homestead, Kimberley. | Mt. Marmion, Kimberley. | Two miles east of Selection Homestead, Kimberley. | Liveryuga Beds, North of Hill, Kimberley. | 8½ miles north of Nerrima Homestead, Kimberley. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Amplexus ? pustulosus* Hudl. | × | × | × | | | | | | | | | |
| *Gerthia sulcata (Hinde)* ... | — | — | — | × | | | | | | | | |
| *Plerophyllum australe* Hinde | — | — | × | × | — | — | × | | | | | |
| *Euryphyllum trizonatum* sp. nov. ... ... ... | — | — | — | × | — | — | — | — | — | — | — | ? |
| *E. minutum* sp. nov. ... | — | — | — | — | — | × | — | — | — | — | | |
| *Tachylasma densum* sp. nov. | — | — | — | — | — | × | — | — | — | — | × | |
| *Tachylasma* sp. ... ... | — | — | — | — | × | × | — | — | — | — | | |
| *Verbeekia talboti* (Hosking) | — | — | — | — | — | × | — | — | × | | | |
| *Monilopora ? nicholsoni* Eth. | — | — | — | — | — | — | — | — | × | | | |
| *Thamnopora marmionensis* (Eth.) ... ... ... | — | — | — | — | — | — | — | — | × | | | |
| *Thamnopora immensa* sp. nov. ... ... ... | — | — | — | — | — | — | — | × | — | × | | |

*Age of the Coralliferous Beds.*—Workers on Upper Palaeozoic stratigraphy and faunas have not yet reached unanimity of definition for the term Permian. The lower limit of the Permian has been placed at many different horizons, and when dealing with any fauna it is necessary to indicate which terminology is being followed. In this paper I shall follow the terminology

of Haniel (1915), modified by Miller (1933). Both these workers have dealt with ammonoid faunas and their results agree reasonably well. The table shows their interpretation of Permian horizons:—

| | Haniel, 1915, p. 19. | | Miller, 1933, p. 425 |
|---|---|---|---|
| Neodyas | Amarassi ... Oberer<br>(Timor) ... Mittlerer | Productuskalk<br>(Salt Range) | = Upper Permian |
| | Basleo (Timor) ... ... | | = most of Sosio beds (Sicily). Delaware Mts. Formation and Word Formation of Texas = Middle Permain |
| Palaeodyas | Bitauni (Timor) ... Obere Artinsk, Sosio, Wichita | | = Artinskian, and some of Sosio beds = Lower Permian. |
| | Atsabi (Timor) ... ... ... ... | | |
| | Somohole (Timor) Unterste Artinskstufe | | |
| Obercarbon | ... ... ... ... ... (Uralian) | | = Upper Pennsylvanian. |

Schuchert (1928) and Heritsch (1934) regard the Artinskian as the upper part of the Lower Permian; they include the underlying *Schwagerina* beds of the Urals in the Lower Permian, and place the Gshelian *Cora-* and *Omphalotrochus* beds at the top of the Upper Carboniferous. Ting and Grabau (1934) regard the Artinsk as Middle Permian, and place the whole of the Uralian (*Schwagerina-*, *Cora-* and *Omphalotrochus*-beds) in the Lower Permian. Fredericks and Emeljantzev (1934 p. 18), also regard the Artinsk as Middle Permian, but place the Uralian in the Upper Carboniferous, stating that in Lower Permian times there was an orogenic phase in the Urals. They differ from other authors also in considering the *Schwagerina* beds to be below the *Cora-* and *Omphalotrochus* beds.

The geological range of the genera and species described in this paper is given under their description. All the Rugose genera (excepting *Amplexus* Sowerby, to which our species is doubtfully referred) are confined to the Permian; none occur in the Upper Carboniferous (Uralian); both Tabulate genera are very long ranged, but the species resemble Permian species. All the Australian localities mentioned are therefore Permian. Whether they are Lower or Middle Permian cannot be deduced with certainty from the corals, owing to the insufficiency of our knowledge. Permian corals have been described from very few places, such as Timor, the Northern Urals, the Oufimskoe Plateau, and China.

## GENUS **AMPLEXUS** SOWERBY.

*Amplexus* Sowerby, 1814, vol. I., p. 165.

*Genotype* (by monotypy): *Amplexus coralloides* Sowerby, *loc. cit.*, pl. lxxii., Black Rock (Lower Carboniferous Limestone), Limerick, Ireland.

*Diagnosis.*—Simple cylindrical Rugose corals with distant, flat, complete tabulae, and short septa which are fully developed only on the upper surfaces of the tabulae, but above these positions extend progressively a shorter distance from the epitheca; there are no dissepiments.

*Remarks.*—The simple structure of this genus may be a morphological end-point for many lineages. Some of the Permian amplexoids seem to me to have important differences in the septa and their structure; thus many have continuous club-shaped septa; some have dissepiments.

## Amplexus? pustulosus Hudleston.

(Plate 1, fig. 1; text-fig. 1.)

*Amplexus pustulosus* Hudleston, 1883, p. 591, pl. xxiii., figs. 1a, 1b, 1c. "Fossil Range," Gascoyne River [Permian].

*Amplexus pustulosus;* Hinde, 1890, p. 194 (partim), Gascoyne River [Permian].

*Amplexus pustulosus;* mentioned Etheridge, 1903, p. 8, from Williambury Station, Minilya River, Gascoyne District. Specimen not examined by me.

*Amplexus pustulosus;* Glauert, 1910, p. 82; 1925, p. 45.

*Amplexus coralloides* Sow. var. *pustulosus* Hudleston; Gerth, 1921, p. 96.

*Material*: Lectotype (here chosen) and figured R. 2275, British Museum; Forrest collection; figured Hudleston *loc. cit.* fig. 1a.; Fossil Range, near junction of Gascoyne and Lyons Rivers, north of Western Australia.

The other syntypes are lost. They were presented, in the Forrest Collection, to the Geological Society, whence specimens collected outside the British Isles were transferred to the British Museum in 1911. I understand from Miss Hosking that none of Hudleston's type material is in Western Australia. Other Specimens, R. 13972-3 and R. 13977-8, British Museum, were collected by H. P. Woodward and mentioned by Hinde, 1890, p. 194, as from the "Carboniferous" [Permian] of the Gascoyne River, Western Australia. R. 13974-6 also described by Hinde *loc. cit* as *A. pustulosus*, are *Plerophyllum australe* Hinde, from the Gascoyne River [Permian]. R. 13979, in the British Museum, said to be a paratype, is, however, much smaller than the holotype, with coarse longitudinal ribbing, and has the tip broken off, showing 5 prominent septa; so it also is probably *Plerophyllum* sp.

*Diagnosis.*—Erect, turbinate Rugose corals with the septa dilated and laterally contiguous, leaving a wide axial area free of septa.

*Description.*—The five incomplete specimens (B.M.R. 2275, R. 13972-3, 13977-8) on which this description is based are much crushed. They are erect and turbinate, the largest having a height of 60 mm., and a diameter at the calice of 40 mm. The nature of the crushing suggests that the calice was deeper than the diameter of the corallite. The epitheca and probably also the minor septa are eroded away, but curious pustules, which appear not to be part of the coral tissue, are seen on the surface of the holotype. Their exact nature is not known, owing to the poverty of material. The specimens show longitudinal striation, but this is due to weathering, the extremely narrow interseptal loculi showing as narrow grooves.

A transverse section of 15 mm. diameter taken from the broken base of the specimen shows 34 major septa only, dilated so that they are laterally contiguous, extending two-thirds of the way to the axis. Each shows a very distinct "median dark line," but re-crystallisation prevents any description of the grouping of the fibres. The transverse section suggests that the peripheral parts of the coral, where possibly minor septa were present, have been eroded away.

Of the tabulae nothing is known. The calcite in the empty axial part of the section is strongly re-crystallised, and the acicular crystals are arranged in groups.

*Remarks.*—Only the holotype of the type material can be traced, as above mentioned; while, of the specimens referred to the species by Hinde, only four are possibly conspecific, and these are too crushed for accurate determination. The material is so poor that it cannot be referred with certainty to any genus. Until other specimens are found, the species is best referred doubtfully to *Amplexus*, in which it was first placed, and under which it appears in the literature. Gerth (1921 p. 96) considers that it may be only a variety of *Amplexus coralloides* Sow. [Lower Carboniferous], but with this

I cannot agree. He describes, under the genus *Amplexus*, six species from the Permian of Timor, with short septa and distant, flat tabulae; one of these, *A. abichi* Waagen and Wentzel, occurs also in the Permian of the Salt Range. But in none of these forms are the septa so dilated as to be laterally contiguous throughout their length, and the Australian species does not appear to be closely related to them.

### Amplexus cf. nodulosus Phillips.

*Amplexus* cf. *nodulosus* Phillips; Hudleston, 1883, p. 591; Glauert, 1910, p. 82; a specimen in the Forrest Collection marked 1, believed by Hudleston to be from "Fossil Range," north of the Lyons River, Gascoyne District, Western Australia. This specimen was recorded by name only and has not been traced; it can hereafter be omitted from faunal lists.

## GENUS GERTHIA GRABAU.

*Gerthia* Grabau, 1928, p. 29.

*Genotype*: *Polycoelia angusta* Rothpletz, 1892, p. 69, pl. xii., figs. 23, 31, 32. Upper Permian of Ajermati, Timor.

*Diagnosis.*—Simple, ceratoid, rugose corals with a peripheral stereozone, with the cardinal, counter and two alar septa more prominent than the remainder, and with septal insertion accelerated in the counter quadrants. There are no dissepiments, and tabulae are not known.

*Remarks.*—The genus is known from Timor, at Ajermati, Amarassi, and Basleo. From their ammonoids Haniel (1915, p. 19) regarded the two former localities as Upper Permian, and the last as between Upper and Lower Permian; Miller (1933, p. 425) called the Basleo beds Middle Permian. It is represented in the Lower Permian (Soschkina, 1928) of the western parts of the Northern Urals. Grabau *loc. cit.* has tentatively placed in it *Astrocyathus incisus* Ludwig and *Astrocyathus compressus* Ludwig, both from the Lower Zechstein of Posneck in Thuringia. The marked acceleration of the insertion of the septa in the counter quadrants distinguishes the genus from *Polycoelia* King, in which, according to Grabau, insertion is equal in all four quadrants.

### Gerthia sulcata (Hinde).

(Plate 1, fig. 2.)

*Pterophyllum sulcatum* Hinde, 1890, p. 197, pl. viii. A, figs. 2, 2a [Permian], Irwin River, Little Champion Bay, Victoria District.

*Pleurophyllum* (sic) *sulcatum*; Glauert, 1910, p. 83.

*Gerthia* (?) *sulcata*; Grabau, 1928, p. 34, pl. i., fig. 4 (a reproduction of Hinde's fig. 2a., *loc. cit.*).

*Holotype*: British Museum R. 2274 (figured Hinde *loc. cit.* and Grabau *loc. cit.*) the only specimen known, locality and horizon as above.

*Diagnosis.*—Large *Gerthia* with the septa so dilated as to be laterally contiguous and to fill the lumen.

*Description* (based on the holotype only).—The fragment of corallum is subcylindrical and regularly curved, 4 cm. high and 1·1 cm. in diameter. It shows repeated but not very evident cone-in-cone rejuvenescence, and well-marked interseptal ridges and septal grooves, the grooves for the minor septa being present from the beginning. The calice is not known.

There are 28 slightly rhopaloid[1] septa, all dilated and laterally contiguous, filling the lumen at least in the proximal parts of the corallite. But the cardinal and counter septa and the two alar septa are longer and more dilated than the remainder, and show a stronger tendency towards swelling near the axial edges. The counter septum is longer than the cardinal septum. There are seven or eight septa in the counter quadrants, and four or five in the cardinal quadrants. Minor septa are not seen in the transverse section. The septal structure seems to be similar to that described below for *Plerophyllum australe* Hinde, but owing to the scarcity of material this must remain uncertain. The nature of the tabulae is unknown.

*Remarks.*—In the great dilatation of its septa this species resembles those from the Lower Permian of the western parts of the Northern Urals described by Soschkina (1928) more closely than those described by Gerth (1921) from the Upper and Middle Permian of Timor. The above description will need expansion when more specimens are found. The acceleration of the septal insertion in the counter quadrants is marked. As Grabau has already observed (1928, p. 34) Hinde mistook the counter septum for the cardinal septum. In this species, as in the majority of Permian simple corals, the counter septum is the largest, extending beyond the axis.

## GENUS **PLEROPHYLLUM** HINDE.

*Plerophyllum* Hinde, 1890, p. 195.

*Pleurophyllum* (sic.); Etheridge, 1903, p. 8.

*Plerophyllum*; Gerth, 1921, p. 87.

*Plerophyllum*; Grabau, 1928, p. 45.

*Genosyntypes*: *Plerophyllum australe* Hinde, 1890, p. 196, pl. viii. A., figs. 1a.-1f. [Permian] Gascoyne River, Irwin River; Western Australia.

*Plerophyllum sulcatum* Hinde, 1890, p. 197, pl. viii. A., figs. 2, 2a.

*Genolectotype* (chosen Grabau, 1928, p. 46); *Plerophyllum australe* Hinde *loc. cit.*

*Diagnosis.*—Small, curved, ceratoid rugose corals in which the two counter-lateral septa, both alar septa, and the cardinal septum (and sometimes the counter septum also) are larger and more dilated than the others, but equally developed among themselves, and are swollen near their axial edges. Septal insertion is accelerated in the counter quadrants.

*Remarks.*—The genus (*sensu stricto*) occurs elsewhere in the Lower Permian of the western parts of the Northern Urals, and at Hatu Dame in Timor, and in the Middle Permian at Basleo in Timor. It is not known from Eastern Australia. Gerth (1921, pp. 87 seq.) placed in the genus a number of species from Timor, but most of them have since been removed by Grabau (1928). Grabau defined two other genera according to which of the six proto-septa[2] are longer and more dilated than the other septa. Thus in *Tachylasma* the two counter-lateral and the two alar septa are predominant, and rhopaloid, but the cardinal septum is extremely short, and the counter septum thin. In *Gerthia* the cardinal, counter and two alar septa are predominant and rhopaloid. As Grabau has shown (1928, p. 34, p. 46) *P. sulcatum* Hinde has the septal arrangement characteristic of the genus *Gerthia* Grabau, to which it must therefore be transferred.

[1] Rhopaloid septum Hudson, 1936, p. 90. "A septum increasingly thickened towards a rounded axial edge and club-shaped in transverse section, as in *Plerophyllum* Hinde."

[2] Grabau, like Edwards and Haime, recognises only 4 primary septa—the cardinal and counter and two alar septa. He regards the two counter-lateral septa as accelerated meta-septa. Most British authors recognise 6 proto-septa, the cardinal, counter, two alar and two counter-lateral septa. See Hill, 1935, p. 504.

The Devonian genus *Oligophyllum* Pocta and the Carboniferous genus *Cryptophyllum* Carruthers both have the two counter-lateral, the two alar, and the cardinal septa better developed than the other septa, but *Plerophyllum* can be readily distinguished from these by the clubbed axial ends of the septa, and the much greater length and dilation of all the septa.

*Structure of the rhopaloid septum of Plerophyllum and other Permian Rugose Corals* (Text-fig. 2a-c): A rhopaloid septum (Hudson) is a continuous septum swollen near its axial edge so that it is club-shaped in transverse section. Rhopaloid septa are characteristic of the Permian Rugose genera *Plerophyllum* Hinde, *Tachylasma* Grabau, *Gerthia* Grabau and *Sinophyllum* Grabau, of some Permian amplexoids, of the Tournaisian *Rhopalolasma* Hudson, and of many Hexacorals.

Rhopaloid septa have a characteristic appearance in transverse section. In the middle portion there is usually a median dark band merging without definite boundaries into the outer tissue, which consists of fibres directed at right angles to the median dark band. In the swollen axial portion this dark band may or may not continue; as the axial edge is approached, fibres in the median plane may be seen to lie parallel to the median plane; they curve out in the outer portions so as to cut the margin of the septum at right angles; usually, in the swollen axial portion the median dark band appears to break up into crescentic patches, curved parallel to the axial edge of the septum. Close examination shows that these patches are parts of the divisions between the growth layers of the septum. The median dark line, in this as in other septa, is due to the junction of two differently directed sets of fibres, laid down by the opposing sides of a septal invagination.

My sections indicate that a clubbed septum is formed as follows:—

The septum consists, as described for *Palaeocyclus* (Hill, 1936) of a single vertical series of laterally contiguous monacanths; but in *Plerophyllum* their axes are extremely close together. They arise at the periphery of the corallum and are at first directed steeply upwards, curving towards the axis at a gradually increasing rate so that they cut the axial edge of the septum at right angles. They are formed at the extreme top of the septal invagination. If they were not dilated laterally by sclerenchyme laid down by the sides of the septal invagination, the septum would be attenuate. But the sides of the septal invagination secrete layer after layer of sclerenchyme, consisting of fibres continuous with the fibres of the trabeculae, and at right angles to the surfaces of the layers. The growth lamination of this dilating sclerenchyme is usually emphasised in Permian corals by a separation along the divisional planes, or a deposition of some impurity there; the layers may be traced on the sides of the septum as fine raised lines curving down towards the axis from the periphery (*i.e.*, at right angles to the course of the trabeculae). Lateral growth of the septa is greatest near their axial edges, where the invagination swells, and the septum becomes very dilated; vertical growth of the septa is greatest at their peripheral ends.

The meta-septa in *Plerophyllum* are usually not rhopaloid, and in transverse section the median dark plane usually continues to the axial edge. The fibres of the dilating sclerenchyme are directed at right angles to the median plane of the septum, but slightly upwards, since in transverse section they are at right angles to the median plane, and in vertical section they are pinnately arranged with regard to the median plane.

**Plerophyllum australe** Hinde.

(Plate 1, figs. 3-6; text-fig. 3.)

*Plerophyllum australe* Hinde, 1890, p. 196, pl. viii. A., figs. 1a.-1f.; [Permian] Gascoyne River; Irwin River, Little Champion Bay, Victoria District.

*Pleurophyllum* (sic) *australe*; mentioned Etheridge, 1903, p. 8, Williambury Station, Minilya River; Fossil Hill, Wyndham River (both in the Gascoyne District).

*Pleurophyllum australe*; Etheridge, 1907, p. 27, pl. vii., fig. 1, pl. viii., fig. 10, from the Irwin River.

*Pleurophyllum australe*; Glauert, 1910, p. 83; 1925, p. 45.

*Pleurophyllum australe*; Etheridge, 1914, p. 13, Mt. Marmion, Kimberley District.

*Plerophyllum australe*; Grabau, 1928, p. 46, pl. i., figs. 5 and 6.

*Plerophyllum australe;* Hosking, 1931, pl. 11, pl. iii., figs. 4-6, [Permian] of creek half mile west of Callytharra Springs, Wooramel River, and south bank of the Wooramel River, below Callytharra Springs, Western Australia.

*Syntypes*: in British Museum; R. 2273, figured 1890, pl. viiia., fig. 1a., Gascoyne River; R. 13983, figured *loc. cit.*, fig. 1d., Irwin River; R. 13984, figured *loc. cit.*, fig. 1e., Irwin River; R. 13985, Gascoyne or Irwin Rivers.

*Lectotype* (here chosen): B.M.R. 13984, Irwin River [Permian].

*Other specimens examined*: Sedgwick Museum A. 4743 from the Permian of Irwin River; A. 4752-4 from the Permian Callytharra Limestone, Callytharra. Three (H. 23) in the Collection of the University of Western Australia, Permian, Irwin River.

*Diagnosis.—Plerophyllum* with the septa dilated throughout and laterally contiguous in the proximal parts of the corallum.

*Description.*—The corallum is small, ceratoid and straight or curved. The curvature may be regular or slightly irregular, and the direction of growth may change slightly. The average height of the corallum is about 3 cm., and the diameter at the calice varies from 10 mm. to 14 mm. The calice is conical, and very deep, and very small minor septa are observed in its upper parts. The epitheca is striated longitudinally, the septal ridges being rounded, and twice the number of the major septa, so that minor septa are potential even in the distal parts. Transverse striation is faintly marked. The corallum may be buttressed at its base by a talon. The plane of symmetry of the corallum rarely coincides with the plane of the cardinal and counter septa.

The septa are rhopaloid, club-shaped in transverse section. In transverse section only dilated major septa are apparent. In the proximal parts of the corallum they are so dilated as to be laterally contiguous throughout; but towards the calice dilatation may be less marked in a zone half-way between the periphery and the axis, so that there is a peripheral and an axial stereozone. In the calice the septa are free except in the peripheral stereozone. The cardinal septum, the two alar and the two counter-lateral septa are developed to an equal size and are much larger and more dilated and have a more club-shaped section than the counter septum and the metasepta. The size and degree of dilatation of the meta-septa depends on their order of insertion; but occasionally the meta-septum in the middle of a quadrant may be longer than those previously formed.

Tabulae are seldom developed, since the dilatation of the septa fills the interseptal loculi. But where observed they are distant, dilated, and gently inclined downwards from the axis to the periphery.

*Remarks.*—The species is closer to *P. radiciforme* Gerth from the Middle Permian of Basleo, Timor, than to *P. weberi* Gerth from the Artinskian (Lower Permian) of Hatu Dame, Atsabi, Timor, or *P. hexaseptatum* (Soschkina) from the Lower Permian of the western parts of the Northern Urals. In the two latter species the counter septum also is longer than the meta-septa.

As Grabau surmised (1928, p. 46) Hinde made an error in assuming that the short septum between two long ones was the cardinal septum. It is in reality the counter septum, as proved by the order of insertion of the septa, deduced from the interseptal ridges on the epitheca, and the relative sizes of the meta-septa. No trace of the minor septa can be seen in transverse sections taken below the calice; but their interseptal ridges on the epitheca are present throughout, and they can be seen at the distal margin of the calice. This is an example of extreme lateness of appearance of the minor septa. The greater length of the meta-septum in the middle of a quadrant may be of significance in a discussion of the manner in which the Hexacoral septal insertion was derived from the Rugose septal insertion.

Three specimens from the Callytharra Limestone (Callytharra) Wooramel River (S.M. A. 4752-4) show a decrease in the dilatation of the septa in a zone of variable width mid-way between the periphery and the axis; and in the interseptal loculi distant, dilated tabulae are developed, inclined from the axis to the periphery.

## GENUS **EURYPHYLLUM** GEN. NOV.

*Genotype*: *Euryphyllum reidi* sp. nov. Permian, Upper Dilly Marine stage, Cabbage Creek, Springsure District, Queensland [= Lower Bowen (Reid, 1930, p. 93)]. Holotype is L. 237a. in the University of Queensland collection.

*Diagnosis.*—Simple, almost erect turbinate to ceratoid Rugose corals with well-marked interseptal ridges; the major septa are grouped about a narrow closed cardinal fossula, and are dilated and laterally contiguous except in a zone of variable width midway between the periphery and the axis; very short minor septa appear late, and remain buried in a peripheral stereozone. Tabulae are distant, usually much dilated, complete or incomplete, and inclined from the axis to the periphery. There are no dissepiments.

*Remarks.*—The genus is known only from the Permian of Australia, and of Timor (Wesleo, *Zaphrentis cainodon* Koker, 1924, p. 9, *non* Etheridge), the "Permo-Carboniferous" Maitai Limestone of New Zealand ("*Zaphrentis* sp. cf. *gregoryana*, Trechmann, 1917, p. 61, pl. IV., fig. 7), and the Artinskian of the Western Urals (*Stereolasma minus* Sochkine, 1925, pl. I., figs. 6, 6a). It is common in the equivalents of the upper part of the Lower Marine stage of the Hunter River succession of New South Wales. It is zaphrentoid, but it may be distinguished from all other zaphrentoid coralla by the characteristic dilatation of its tissue. It is quite different from the type species of *Zaphrentis*, *i.e.*, *Turbinolia* (*Zaphrentis*) *phrygia* Rafinesque and Clifford 1820 [= *Caryophyllia cornicula* (Lesueur) 1820 = *Caninia punctata* d'Orbigny 1850 = *Zaphrentis cornicula* (Lesueur) Edwards and Haime 1851] from the Middle Devonian of the Falls of Ohio. In the ephebic stage, *Z. phrygia* has long minor septa, dissepiments, and carinate septa, and has developed much further than the "Zaphrentoid stage."

The Lower Carboniferous *Hapsiphyllum* Simpson [type species *Zaphrentis calcariformis* Hall from the Corniferous limestone (Middle Devonian) of the Falls of the Ohio, Kentucky], has the structure usually called Zaphrentoid, but differs from *Euryphyllum* in dilatation and ontogeny.

Altogether it seems advisable to give this Permian genus a new name, so that its origins need not be confused. The relations of the species described by Etheridge (1891, p. 9) from the Upper Marine group (Permian) of New South Wales as *Zaphrentis* (*Plerophyllum*?) spp. cannot be made out from the figures, and I have no specimens for comparison.

The septa of *Euryphyllum* have throughout the same structure as that described for the meta-septa and for the unswollen portions of the clubbed septa of *Plerophyllum*. The median dark plane is very pronounced, and the growth lamination is emphasised, while the fibres can rarely be seen. Where the fibres can be seen they are at right angles to the median dark plane in transverse section of the septum, and directed slightly upwards from this plane in vertical section. Presumably the arrangement of the trabeculae is as postulated for *Plerophyllum*. The stereozone rarely shows the median dark planes of its constituent septa, but in it the growth layers of neighbouring septa meet in an arch or curve.



**Euryphyllum trizonatum**, sp. nov.

(Plate 1, fig. 7; text-fig. 4.)

*Holotype*: H. 22a., Collection of the University of Western Australia, from the Permian of Fossil Cliff, Irwin River, Victoria District.

*Syntypes*: A. 8643, Sedgwick Museum, and H. 22b., Collection of the University of Western Australia, from the same locality and horizon.

*Diagnosis.—Euryphyllum* with complete dilatation of the septa confined throughout to a regular narrow peripheral stereozone and the axial region.

*Description.*—The corallites are simple, turbinate, and almost erect. The direction of slight curvature is not quite constant, and the plane of symmetry at any part of the corallum is not always in the fossular plane. The two complete corallites were 20 mm. tall and 13 mm. in diameter at the calice; the third corallite was incomplete, but had a diameter at the calice of 23 mm. The calice is half as deep as the height of the corallum. The epitheca shows coarse longitudinal ribbing, the interseptal ridges being high, and as wide as the septal grooves. There are septal grooves indicating potential minor septa.

In ordinary transverse section only major septa are seen, and they number 24 at a diameter of 8 mm., and 32 at a diameter of 20 mm., but in a section through the upper parts of the calice short minor septa may be distinguished in the peripheral stereozone. The septa are dilated and in contact peripherally, forming a very regular peripheral stereozone at least one tenth the diameter of the corallum; they are then suddenly much less dilated, and leave interseptal loculi styliform in transverse section; their axial ends are confluent, and thus form a dense axial structure. The length of the septa varies slightly, depending directly on their order of insertion. The fibres forming the septa are directed at right angles to the "median dark line," and the growth lamination of the septa is parallel to the median dark line.

The cardinal fossula is narrow, closed and parallel-sided, extending almost to the axis. The cardinal septum bisects it, and extends from the stereozone to the axis. There are equal numbers of meta-septa in cardinal and counter quadrants.

Tabulae are seen in transverse section, but their nature is unknown in vertical section.

*Remarks.*—A specimen (B.40) from the fossiliferous limestone 8½ miles north of Nerrima Homestead, Kimberley, has 40 septa at a diameter of 20 mm., and much greater dilatation than the syntypes. Probably, however, it belongs to this species. Some specimens of *Euryphyllum reidi* Hill from the Upper Dilly marine stage of the Lower Bowen beds [=Lower Marine of New South Wales Hunter River succession] closely resemble this species, but they show a much more extensive and far less regular dilatation of the septa. In most Rugose corals dilatation appears to be a primitive character, and it may reasonably be assumed that the Western Australian species has reached a higher stage of development than the Queensland forms, and that it is therefore rather younger.

*Zaphrentis postuma* Smith (1931, p. 4), from the Upper Carboniferous of South Wales, in its adult stage somewhat resembles the West Australian species, but it has fewer septa, a narrower stereozone, and its septa are never so dilated as to fill the lumen.

### **Euryphyllum minutum** sp. nov.

(Plate 1, figs. 8-11; text-fig. 5.)

*Holotype*: Sections a., b. on slide H. 24, in the Collection of the University of Western Australia, from the Permian of creek half a mile west of Callytharra Springs, Wooramel River, Western Australia. There are five other fragments. The sections c., d., also mounted on slide H. 24, are doubtfully referred to this species.

*Diagnosis.*—Minute ceratoid *Euryphyllum.*

*Description.*—The coralla are ceratoid, and not quite erect. The direction of slight curvature is inconstant, and the plane of symmetry at any part of the corallum is not always in the fossular plane. The coralla are from 8 to 10 mm. tall, attaining a calical diameter of 4 mm. The calice is one-third as deep as the height of the corallum. The epitheca shows coarse longitudinal ribbing, and grooves indicating potential minor septa are present. Fine growth annulation is seen.

In transverse section only major septa are seen; there are 18 at a diameter of 3 mm. They are dilated and in contact peripherally, forming a stereozone 1 mm. wide, in which they cannot be traced individually; their axial ends run together in groups, those of each quadrant uniting together before joining the 6 proto-septa at the axis. The fossula is closed and expanded towards the axis, and is bisected by the cardinal septum.

Tabulae are complete, distant and dilated, and are inclined gently from the axis towards the periphery.

*Remarks.*—The species differs from *E. trizonatum* in its small size, and the less radial arrangement of its septa. It is very close to the Artinskian *Stereolasma minus* Sochkine (1925, fig. 6, 6a) in size, but its septa are less radially arranged than in the Russian species.

## GENUS **TACHYLASMA** GRABAU.

*?Ufimia* Stuckenberg, 1895, p. 187.

*Tachylasma* Grabau, 1922, p. 34, 1928, p. 44.

*?Rhopalolasma* Hudson, 1936, p. 92.

*Genotype*: *Tachylasma cha* Grabau, 1922, p. 35, pl. I., figs. 2a., b. and text-fig. 50 on p. 36 [?Carbonic, ?Yunnan, ?South China]. The label of this specimen was lost before the species was described. It seems that Grabau later (1928, pp. 54-147) considered the genus to be Permian only.

*Diagnosis.*—Simple Rugose corals in which the meta-septa are subequal, the two alar and two counter lateral septa tend to be most prominent, and the cardinal septum is more or less aborted. Typically the septa are dilated and have swollen, rounded axial edges. Septal insertion is accelerated in the counter quadrants. Tabulae are not well developed, and there are no dissepiments.

*Remarks.*—The genus is one of a Permian group in which various of the proto-septa are more prominently developed than the remaining proto-septa, and the meta-septa. Acceleration of septal insertion in the counter quadrants is noticeable. The genus is widespread. It occurs in the Upper, Middle and Lower Permian of Timor; in the Artinskian (Lower Permian) Trogkofelkalk of the Carnic Alps (Heritsch, 1934); in the Lower Permian (Artinskian) of the Urals and the Oufimskoe Plateau; and in many Permian localities in China.

The genus is probably a synonym of Stuckenberg's Carboniferous (?)genus *Ufimia* (Genotype *Ufimia carbonaria* Stuckenberg, 1895, p. 188, pl. II., figs. 2, 3; pl. III., fig. 3, from the River Ufa, in the Urals), although Grabau (1928, p. 53) considers the two to be separate; since I have no Russian material, I cannot settle the matter. *Rhopalolasma* Hudson (1936, p. 92) from the Tournaisian of England, is also possibly synonymous, although Hudson considers it to be a homeomorph only. There are no important morphological differences between the three genera.

### **Tachylasma densum** sp. nov.

(Text-fig. 12.)

*Holotype*: B. 126a., in Dr. Arthur Wade's collection, from the third band of Liverynga Beds, North of Hill C., Freney Oil Area, Kimberley, Western Australia. Permian. Fragments of two other specimens are known from the same locality.

*Diagnosis.*—*Tachylasma* with septa dilated and in contact until just below the calice.

*Description.*—The corallum is trochoid, and slightly curved, attaining a diameter of 25 mm. in a height of 30 mm. The epitheca of the syntype is weathered off, and the calice filled with matrix.

At a diameter of 18 mm. there are 37 major septa, and very short minor septa in some of the loculi. The septa are dilated and in contact save for a narrow zone just inside the periphery, and are swollen very little more near their axial edges. The two counter lateral and the two alar septa are the largest and most dilated. The cardinal septum is extremely short, and the counter septum thin and of an intermediate length. There are 10 major septa between counter and alar septa; between alar and cardinal septa there are 7 major septa. The meta-septa are extremely irregular in length. The fine structure of the septa is as described in *Plerophyllum*. The tabulae are not seen owing to the excessive dilatation of the septa, and there are no dissepiments.

### **Tachylasma** sp.

(Plate 1, fig. 12.)

The distal portion of a corallum probably belonging to the genus *Tachylasma* Grabau has been collected from a creek half a mile west of Callytharra Spring, Wooramel River. It is 1/4978 in the collection of the

Geological Survey of Western Australia. It expands in 10 mm. from a diameter of 18 mm. to a diameter of 21 mm., and then rejuvenescence occurs, whereby the diameter is rapidly and evenly reduced. There is coarse longitudinal ribbing of the epitheca, the septal grooves being as wide as the interseptal ridges. Fine transverse striation is present.

In the only section obtainable, taken immediately at the floor of the calice, there are 25 unequal major septa alternating with short equal minor septa. They are dilated and in contact only at the periphery, where they form a stereozone 1 mm. wide. The septa, which presumably are the two counter-lateral and the two alar septa, are more prominently developed than either the counter septum or the cardinal septum, and the latter is shorter than any of the others. Of the meta-septa, those first formed are shorter than those immediately following, as in typical *Tachylasma*. None of the septa reach the axis, and their axial edges are only slightly swollen to a club-shape.

*Remarks.*—Although one cannot be certain that the septa taken for the proto-septa in the above description are correctly named, since the early stages of the corallum are destroyed, I think the assumptions made are reasonable, and that in all probability the specimen belongs to the genus *Tachylasma*. It differs from *T. densum* in the smaller number of septa and in the lack of dilatation. The septal structure of the fragment is that normal in *Tachylasma*, which is the same as that described above for *Plerophyllum*.

## GENUS **VERBEEKIA** PENECKE.

*Verbeekia* Penecke (in Verbeek), 1908, p. 673.
*Dibunophyllum* (*Verbeekiella* sic); Gerth, 1921, p. 84.
*Verbeekia*; Soschkina, 1928, p. 385.

*Genotype*: *Verbeekia permica* Penecke *loc. cit.* from the Permian of Ajermati, Timor = *Dibunophyllum australe* Rothpletz, 1892, p. 70, pl. XII., figs. 19, 24, 20a (?), non 20, 25, 14; pl. XI., figs. 7, 9 (?), from the Permian of Ajermati, Timor = *Clisiophyllum australe* Beyrich, 1865, p. 85, pl. II., figs. 7a., b., 8a., b., 9.

*Diagnosis.*—Simple Rugose corals typically with much-dilated skeletal elements; with a clisiophyllidan axial column, with domed tabulae, and without dissepiments.

*Remarks.*—Gerth has examined Penecke's and Rothpletz's material; he has concluded that Penecke's *Verbeekia permica* is but an elongate form of *D.* (*V.*) *australe* Gerth, with less dilatation, and that it is characteristic of Ajer mati, and is identical with *Clisiophyllum australe* Beyrich from Ajer mati. Gerth has called the Ajermati type *Dibunophyllum* (*Verbeekiella*) *australe forma elongata;* but strictly speaking this type is the genotype, and Gerth's *D.* (*V.*) *australe* should have been made the *forma*. Of Rothpletz's figured specimens, Gerth has concluded that pl. XII., figs. 20, 25 and 14 represent a different species. The narrow peripheral stereozone and the lack of dissepiments is characteristic of most Permian corals. I do not think it likely that this genus is derived from the Clisiophyllidae of the Lower Carboniferous. It more probably represents a new stock. In the proximal part of the corallites, the vertical skeletal elements are so dilated that horizontal elements do not develop, but the dilatation decreases distally, and horizontal elements develop. Such conditions seem to be characteristic of new stocks.

Considerable differences in the arrangement of the septal lamellae are shown by those simple Permian corals with an axial column. These differences are those found within the family Clisiophyllidae of the Lower Carboniferous (*e.g.* in *Dibunophyllum, Aulophyllum and "Centrephyllum"*) and

within the species *Symplectophyllum mutatum* Hill from the Lower Carboniferous of Queensland. Until a large amount of the Permian material can be investigated, I propose to include under *Verbeekia* Penecke all such Permian corals, *e.g. Carcinophyllum cristatum* Gerth, *Dibunophyllum rothpletzi* Gerth, *D. tubulosum* Gerth, *Clisiophyllum australe* Beyrich, *C. torquatum* Rothpletz and *C. talboti* Hosking. Mlle. Soschkina (1928, p. 386), has already referred *D. rothpletzi* Gerth to *Verbeekia*.

The genus as thus constituted is known elsewhere from the Lower Permian of the western parts of the Northern Urals, and in the Lower, Middle and Upper Permian of Timor.

### Verbeekia talboti (Hosking).

(Plate 1, figs. 13-17; text-figs. 6, 7.)

*Clisiophyllum talloti* Hosking, 1931, p. 10, pl. III., figs. 1-3 (Permian), creek half a mile west of Callytharra Springs, Wooramel River.

*Syntypes*: Specimens $\frac{1}{4660}$ and $\frac{1}{4962}$ in the Collection of the Geological Survey of Western Australia. Horizon and locality as above.

*Diagnosis.*—*Verbeekia* with dibunophylloid axial structure containing few septal lamellae.

*Description.*—The corallum is simple, trochoid and curved, twisting slightly during growth. Size is variable, but the average height is 35 mm., with a diameter at the calice of 25 mm. The calice is deep, with a boss about one-third the width of the corallum, extending upwards almost as far as the calical margin, separated from the axial edges of the septa by a deep trench which widens suddenly at the fossula. The boss usually shows a median ridge in the fossular plane, and lamellae diverge from the ridge. The calicular platform is steeply sloping, and short minor septa are seen between the major septa. The epitheca shows more or less well-marked interseptal ridges and septal grooves, approximately equal in width indicating that the fossula is on the longest side of the corallum, but not necessarily in the plane of bilateral symmetry of any part of the corallum, and that minor septa are potential throughout. Annulation and low bourrelets are typical.

The septa number 26-34 of each order, but the minor septa seldom appear until just below the calice. They are always more or less dilated; they may be laterally contiguous only at the periphery, forming a narrow peripheral stereozone, or throughout their length; or such complete contiguity may be confined to the septa of certain parts of the corallum only, usually the cardinal quadrants, and a few neighbouring septa. None of the septa are rhopaloid. In transverse section they are seen to consist of fibres directed outwards from a light-coloured medium plane, at first pinnately, but curving gradually or quickly so as to run almost at right angles to the median plane. In vertical section the fibres are directed slightly upwards from the median plane. Growth lamination is never very evident. The septa are believed to consist of monacanths directed distally and towards the axis, as described in *Palaeocyclus* (Hill, 1936), and *Cymatelasma* (Hill & Butler, 1936), but whose axes are very close. There are usually equal numbers of meta-septa in cardinal and counter quadrants. The axial structure consists of a median lamella, which is continuous with the cardinal septum, but may be continuous with the counter septum, septal lamellae numbering from 5-9 on each side, and the axial parts of the tabulae. Dilatation of the skeletal elements may be so great that the structure is quite compact, but usually there are loculi giving the structure

a piped appearance. The tabulae are domed, sometimes dilated, and may be represented by tabellae, especially in the axial structure, but these are never very numerous.

*Remarks.*—The species closest to this is *Verbeekia rothpletzi* (Gerth) from the Lower and Middle Permian of Timor and the Artinskian of the Urals.

### **Zaphrentis** sp. Hudleston.

*Zaphrentis* sp. Hudleston, 1883, p. 590, in Forrest Collection, specimen marked 1, believed by Hudleston to be from "Fossil Range," north of the Lyons River, Gascoyne District, Western Australia. This specimen was recorded by name only, and has not been traced; it can hereafter be omitted from faunal lists.

### GENUS **THAMNOPORA** STEININGER.

*Thamnopora* Steininger, 1831, p. 10; 1834, p 337.

*Pachypora*, Lindström, 1874, p. 14.

*Genosyntypes*: *Thamnopora madreporacea* Steininger, 1831, p. 11, 1834, p. 338 = *Calamopora polymorpha* var. ♀ Goldfuss, 1829, p. 79, pl. xxvii., fig. 4a, *Calamopora polymorpha* var. ♂ Goldfuss, 1829, p. 79, pl. xxvii., fig. 5, and specimens Steininger had in front of him. Middle Devonian, Eifel.

*Thamnopora milleporacea* Steininger, 1831, p. 11, 1834, p. 338, specimens in front of Steininger. Steininger refers to forms figured by Goldfuss, namely, pl. xxvii., fig. 4d, and pl. xxviii., figs. 2a-c as synonyms. Middle Devonian Eifel.

*Genolectotype*: *Thamnopora madreporacea*, interpreted upon the original of *Calamopora polymorpha* var. ♀ Goldfuss, 1829, pl. xxvii., fig. 4a = *Alveolites cervicornis* de Blainville, 1830, p. 370; 1834, p. 405 partim. See Steininger 1831, p. 12, where he restricts the species by excluding *Calamopora polymorpha* var. ♂ pl. xxvii., fig. 5, and he indicates the genotype in the sentence "Ich habe diese Koral von den Alveoliten getrennt und daraus ein besonders Genus mit den Namen Thamnopora gebildet." In case it is contended that this statement does not formally determine the genolectotype, the original of *Calamopora polymorpha* var. ♀ fig. 4a is here chosen as lectotype of *Alveolites cervicornis*, and that species is here selected as genolectotype of *Thamnopora*." (Lang and Smith MS.)

*Diagnosis.*—Ramose Tabulate corals in which the cylindrical branches may be flattened and coalesced; the corallites are typically polygonal, and diverge from the axis of the branch and usually open normally to the surface; the corallite walls are dilated throughout, and the dilatation increases distally; typically the growth lamination in the sclerenchyme of the wall is obvious, while its fibrous nature is not; septal spines are usually obsolete, and mural pores are large.

*Remarks.*—This genus, and morphologically similar genera, their synonymy and morphology, have recently been revised by Drs. Lang and Smith, with the result that what was formerly a completely chaotic and useless group may now be used in exact stratigraphical discussions. The importance of the work which Drs. Lang and Smith are doing in clearing up the generic synonymies of Palaeozoic corals, and in describing the genotypes cannot be over-estimated. I am much indebted to them for allowing me to abstract the above synonymies from their unpublished manuscript. Drs. Lang and Smith will show that *Pachypora* Lindström is synonymous with *Thamnopora*.

The corallite walls are dilated throughout, and the dilatation increases distally and is not concentrated in the higher parts of the corallites as in *Striatopora* and *Coenites*.

The genus is rather rare in the Silurian, and very common in the Devonian. It is not known with certainty from the Carboniferous, but is again very common in the Permian, occurring in Timor, India, Japan and Australia. It is rare in the Trias. The four Permian species from Timor, *T. jabiensis* (Waagen & Wentzel), *T. curvata* (Waagen & Wentzel), *T. lobata* (Gerth), and *T. monstrosa* (Gerth) are characterised by dimorphism of the corallites; the three last also show excessive dilatation of the walls.

**Thamnopora marmionensis** (Etheridge).

(Plate 1, figs. 18-20; text-fig. 8.)

*Favosites marmionensis* Etheridge, 1914, p. 13, pl. I., fig. 1; pl. II., figs. 2-4; pl. VIII., fig. 2 [Permian], Mt. Marmion, Kimberley District, Western Australia. Figured syntypes in the Collection of the Geological Survey of Western Australia.

*Favosites marmionensis*; Glauert, 1925, p. 45.

*Diagnosis.—Thamnopora* forming large lobate masses, with corallites of two sizes opening obliquely to the surface, calices frequently with lower lip semi-circular, and with corallite walls becoming very thick distally; with large irregular mural pores, frequent tabulae and without septal spines.

*Description* (based on two syntypes only).—The corallum is flattened and lobate, and consists of rounded, diverging, but coalesced branches. The larger fragment (text-figure 8) is 55 mm. long, 45 mm. wide at its greatest width, and 17 mm. deep. The average diameter of the branches is 13 mm. In its growth habit the corallum is identical with *T. lamellicornis* (Lindström), except that the individual branches are cylindrical rather than compressed.

The calices are of two sizes, indicating dimorphism of corallites. The larger are 2 mm. in diameter and the smaller 1 mm. In the unworn parts of the common wall between two corallites rises a thin median crest; but in the worn parts the common wall appears as a thick partition. The shape of the calice is very variable. Both sizes may be polygonal, but frequently they may be semi-circular, and the upper lip may be bounded by two such semi-circular lower lips of neighbouring corallites. That is, they are like the calices of *Alveolites,* except that the semi-circular wall is the lower lip in *T. marmionensis,* whereas it is the upper lip in *Alveolites.* Very rarely, low septal striae are observed in the calice, but no opercula have been seen.

The corallites arise by intermural increase at the axis of a branch, where they are vertical: they then diverge, the curvature increasing slightly towards the surface, where they open sometimes at right angles, but sometimes obliquely. The crescentic calices correspond to those corallites opening with the greatest obliquity. The walls of the corallites are dilated; dilatation is slight at the axis of the branch, but increases towards the calice, so that the wall may be as much as 1mm. thick. The common wall between two corallites consists of fibres directed pinnately upwards and towards the axes of the corallites, and does not show the growth lamination typical of most species of the genus. Septal spines do not appear in the sections. Tabulae are poorly developed, complete, and horizontal or inclined. Mural pores are numerous, large (diameter 0.1mm.), and not arranged in regular series. Their course through the dilated wall is rather irregular, and suggests that

in some cases they may be due to a boring organism, as suggested by Lindström for similar "pores" in the Silurian *T. lamellicornis* and in *T. curvata* (Waagen and Wentzel) from the Permian of the Salt Range.

*Remarks.*—The species resembles the four species from Timor in the dimorphism of its corallites. In its dilatation it is closest to *T. curvata* (Waagen & Wentzel), from the Middle Permian of Timor, but differs from this in having a ramose and flattened corallum, rather than a finger-like corallum.

### **Thamnopora immensa** sp. nov.

(Plate 1, figs. 21, 22; text-fig. 9.)

*Holotype*: Specimen here figured, text-fig. 9, H. 25 in the Geological Survey of Western Australia Collection, from two miles east of Selection Homestead, south of Rough Range, Kimberley, from a Permian Polyzoan Limestone.

*Diagnosis.*—*Thamnopora* of large size, in which the corallites are very long, have excessively dilated walls, and numerous large and regular mural pores.

*Description.*—The corallum is very large (largest fragment, text-figure 9, 75 x 65 x 45 mm.), and consists of coalescent and approximately cylindrical branches about 40 mm. in diameter. Unweathered calices are not seen, but they are probably polygonal. The corallites are vertical for a very short distance (5 mm.) and then turn sharply outwards to open at the surface of the branch at right angles. The length of this more or less straight part of the corallites may be as much as 30 mm. The corallites vary in size, the diameter from the median dark line of the walls being from 1 to 2.5 mm. It cannot be ascertained with certainty whether they are dimorphic as in *T. marmionensis*, as the surfaces of the coralla are too weathered.

The corallites are almost completely choked by the dilatation of the walls. Fibres are directed pinnately up towards the axes of the corallites from the median dark line of the common wall, but owing to re-crystallisation it is not possible to ascertain whether the walls consist of trabeculae or not. A space about 0.25 mm. wide may be left at the axis of the corallite, and usually seven or eight tooth-like pieces (which may represent septa) of the dilated wall project into it. Rarely, small circular foramina (about 0.1 mm. in diameter) are seen in vertical sections of the walls, and these are probably mural pores. But the corallum is riddled with the straight, spiral or irregular cylindrical tracks (up to 0.5 mm. in diameter) of boring organisms; usually the axis of the corallite has been excavated, either in a straight or a spiral cylinder, and neighbouring corallites are frequently connected by almost horizontal tunnels, which may or may not occupy the site of mural pores. The borings are usually lined by iron oxide, and may be crossed by thin transverse or slightly concave plates.

Neither septal spines nor tabulae have been recognised with certainty.

*Remarks.*—The species resembles *Thamnopora lobata* (Gerth) and *T. curvata* (Gerth) from the Middle Permian of Timor in filling the lumen of the corallites so completely that they are devoid of true tabulae. It differs from these in forming very large coralla of large coalescent branches.

B. 74, a large finger-like, incomplete branch, from two miles south-east of Christmas Creek Homestead, Kimberley, shows the same spiral tracks of the boring organism. This is in Dr. Wade's Collection.

## GENUS **MONILOPORA** NICHOLSON & ETHERIDGE.

*Monilopora* Nicholson & Etheridge, 1879, p. 293, pl. vii., figs. 2a.-f.

*Genotype* (by monotypy): *Jania crassa* McCoy, 1844, p. 197, pl. xxvii., figs. 4, 4a. [Nicholson and Etheridge's descriptions were based on specimens from the Carboniferous Limestone of Derbyshire and Lancashire. But McCoy's syntypes were from three localities in the Lower Carboniferous of Ireland; that figured *loc. cit.* fig. 4, from Lackagh, Drumquin; that figured *loc. cit.* fig. 4a., St. John's Point, Dunkineely, Killybegs, Donegal Bay; unfigured, a specimen from the Calp of Abbeybay, Ballyshannon. Of the three syntypes, the only one that is wound round a crinoid stem (a condition typical of Nicholson & Etheridge's specimens) is that figured *loc. cit.* figs. 4a.]

*Diagnosis.*—Compound reptant coralla, usually encircling crinoid stems; the corallites are applied to the crinoid stem by one side, but the calices are erect and free laterally, and open approximately at right angles to the attached surface; the corallites have a peripheral stereozone, in which the sclerenchyme is typically reticulate in patches. There are no tabulae, and typically neither septal spines nor striae.

*Remarks.*—The relation between the genera *Monilopora* and *Cladochonus* McCoy is being investigated by Professor L. B. Smyth of Dublin and myself. Our findings are still unsettled, and I shall not anticipate them here.

### **Monilopora ?nicholsoni** Etheridge.

(Plate 1, figs. 23-24; text-figs. 10-11.)

*Monilopora nicholsoni* Etheridge, 1914, p. 14, pl. I., figs. 2-4; pl. vii., fig. 4. (Permian), Mt. Marmion, Kimberley, Western Australia.

*Monipolora nicholsoni;* Glauert, 1925, p. 45.

*Material* here described consists of a number of fragments of coralla in the collection of the University of Western Australia from the Permian of the creek half a mile west of Callytharra Spring, Wooramel River, Western Australia. With it are a number of very slender ceratoid coralla of *Euryphyllum minutum* nov., which might be mistaken for single corallites of *Monilopora ?nicholsoni*, were it not for their coarsely striated epitheca.

*Diagnosis of Callytharra specimens.*—Slender *Monilopora*, with the proximal corallites reptant and embracing crinoid stems.

*Description of Callytharra specimens.*—The corallum is reptant proximally where it embraces thin crinoid stems. The corallites in this reptant portion may give rise to slender non-reptant branches, but if so, in my specimens they are broken off just above the point of issue. A trochoid proto-corallite about 3 mm. high and with a calical diameter of 3 mm., is attached by one side to a crinoid stem. It gives rise through its calical walls to an offset on each side. Each offset is applied by one side to the crinoid stem, and creeps round the stem, its calice becoming free. A new offset continues the encircling of the crinoid stem. The calices of these offsets are 2-4 mm. in diameter, usually 3 mm., and the corallites are curved, ceratoid or scolecoid. They may be 6 mm. from their point of issue to the calice, but are usually about 4 mm. Low septal ridges may sometimes be seen in the calice, and there is a faint longitudinal striation on the epitheca, indicating 18-20 septa. The epitheca also shows fine growth annulation.

In transverse section each corallite has a stereozone regularly about 0.75 mm. wide, so that in the narrow necks connecting calice and offset, the axial space is extremely small, but in the calice it expands considerably. The sclerenchyme does not show indications of fibres, but this is possibly due to

recrystallisation. It shows growth lamination, the laminae being parallel to the epitheca in transverse section, but in vertical section being parallel to the sloping calical platform. No trace of reticulation of the sclerenchyme such as that described in *Monilopora crassa* and *M. beecheri* has been seen, nor have septal spines nor tabulae been observed.

*Remarks.*—This species occurs in the same district and on approximately the same horizon as the syntypes of *Monilopora nicholsoni* Etheridge. Of the latter only slender, short and semi-palmate branches have been described, and of the Callytharra specimens only the attached proximal portions are known. It is probable that only one species is represented at both localities. The size of the calice is fairly constant. Nevertheless *M. nicholsoni* as described by Etheridge differs considerably in having much coarser, even semi-palmate branches—whereas the only branches known from Callytharra are extremely slender, 2-3 mm. only. Miss Prendergast informs me that all the types of *M. nicholsoni* are lost, and in their absence it is considered unwise to separate the Callytharra specimens into a new species. Etheridge remarks that the reticulate structure of the sclerenchyme, claimed by him and Nicholson as diagnostic of the genus, was noted in only one section of the topotypes. I have not found it at all in the Callytharra specimens.

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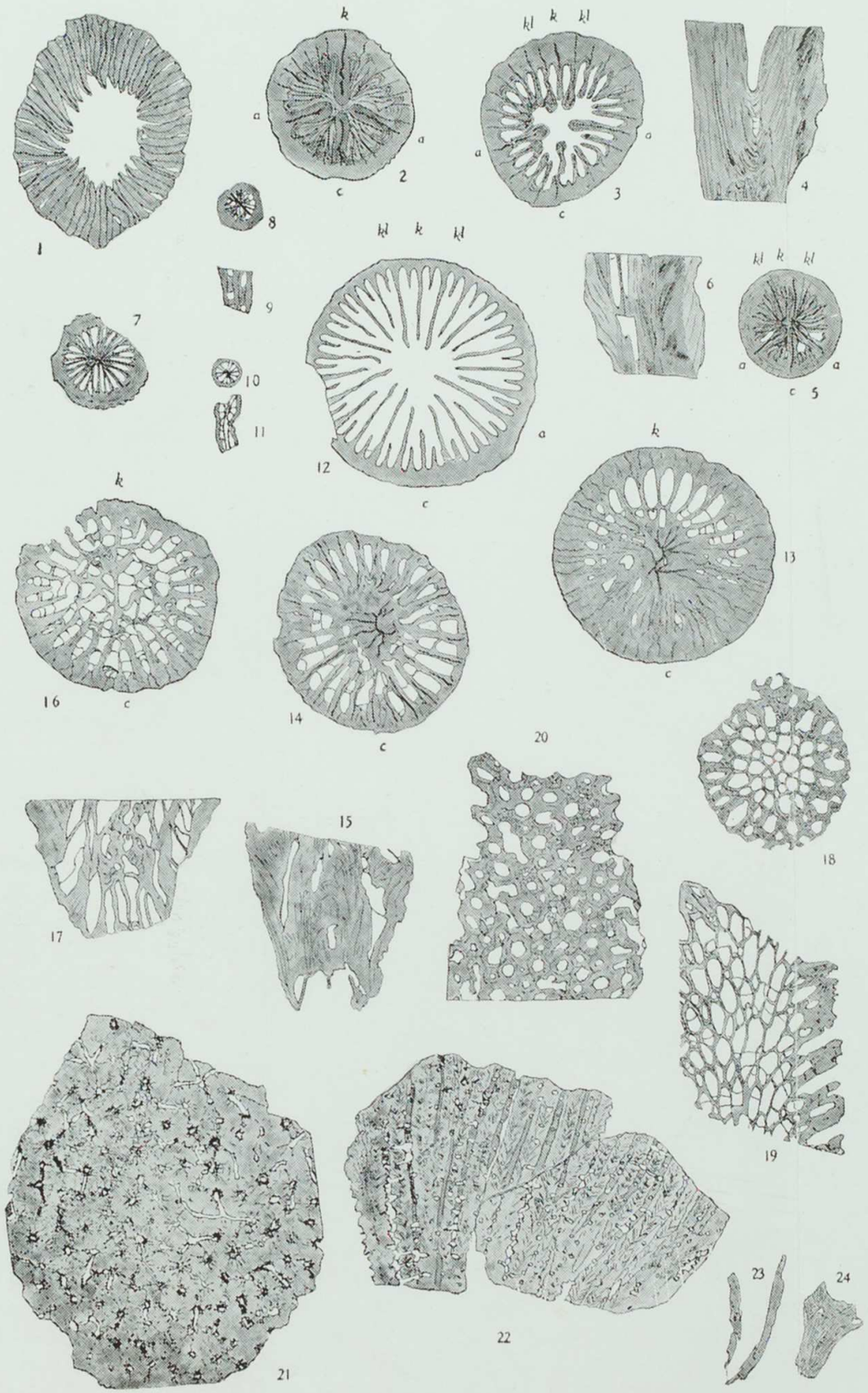
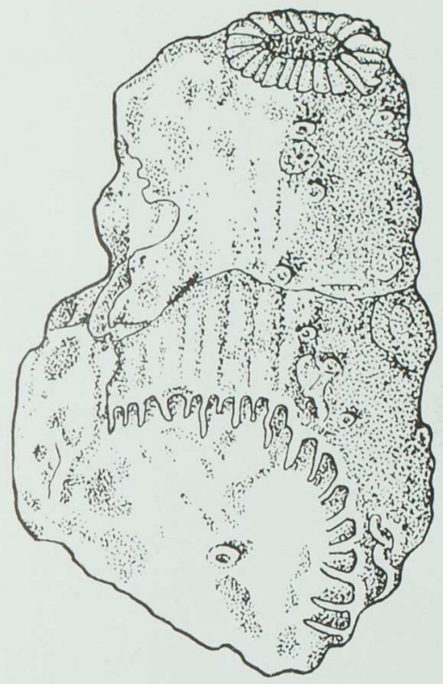


Plate 1.



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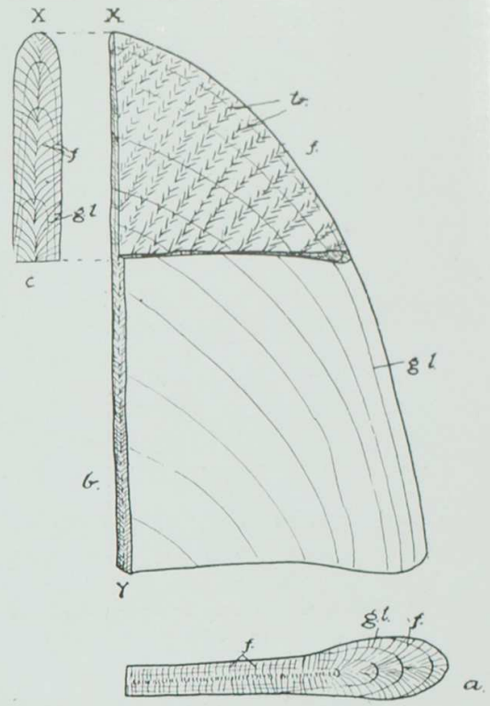

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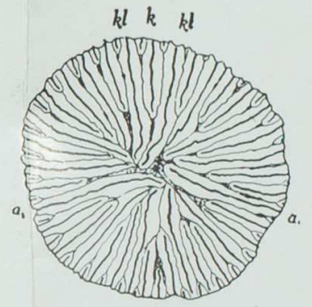

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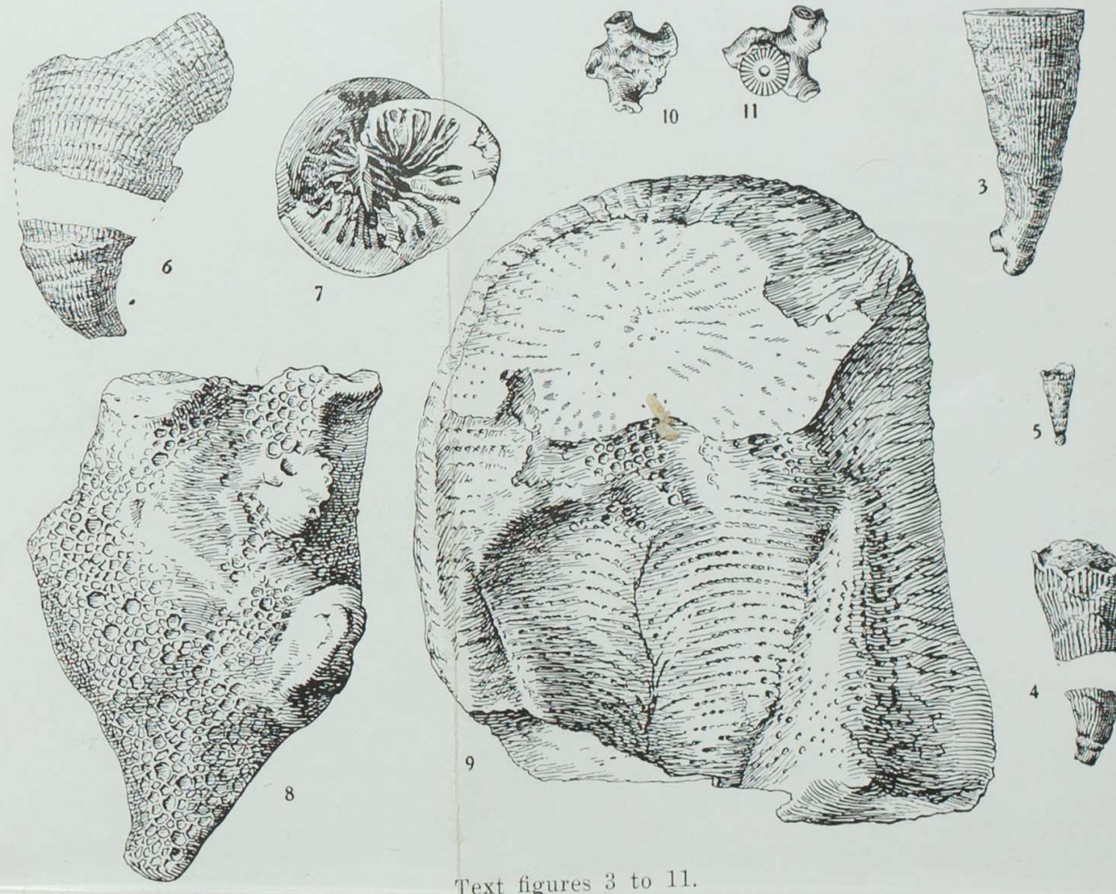

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